

Land-sea interactions and water quality in the Great Barrier Reef Lagoon

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OF MARINE SCIENCE

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The Great Barrier Reef

Marine Park (1975) and WHA (1981)

Largest coral reef system in the world

>3000 reefs;
2,200 km long;
350,000 km²

Shallow lagoon,
wide shelf,

Fringing and
platform reefs



©GBRMPA

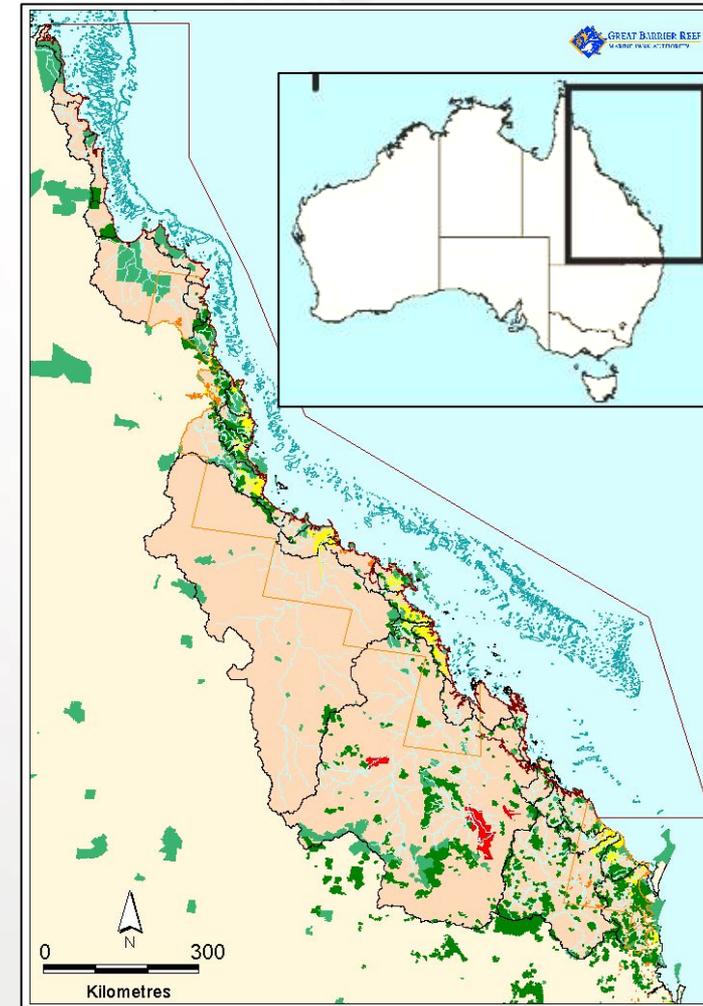


The GBR Catchment

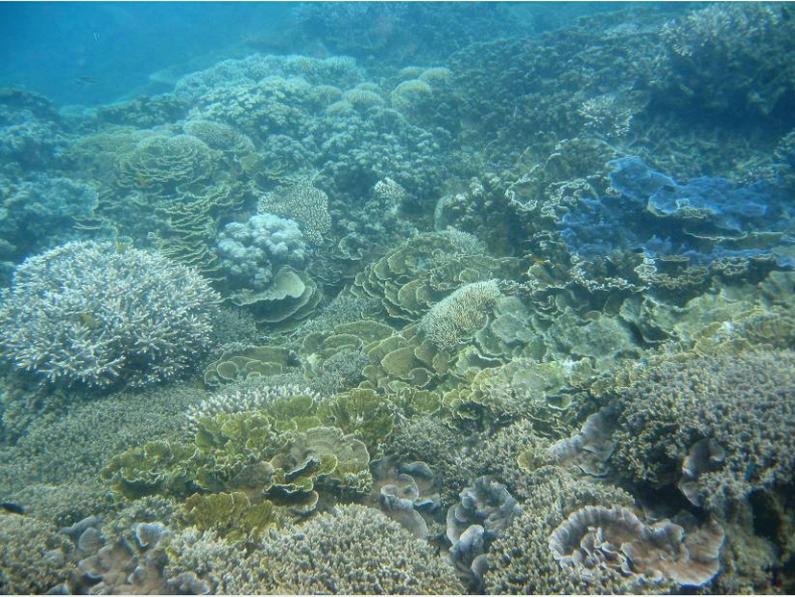
- 422,000 km²
- 26 river catchments
- ~20% “pristine”

Land-uses

- Agriculture (beef & sugar)
- Urban & industrial areas
- Ports
- Aquaculture



The need to meet the challenge of climate change



Current threats to the GBR:

1. Climate change:
Temperature, cyclones,
floods, ocean acidification
2. Water quality: nutrients,
turbidity, sedimentation
3. Fishing and other harvest

Threats to GBR: 1. Water quality

The issue:

- River floods carrying nutrients, sediments and herbicides from eroding farm soils into the sea
- Predicted significant intensification of coastal development in QLD



Catchment to reef connection

GBR rivers export large amounts of

- Freshwater (long-term average ~70 million ML)
- Suspended sediments (long-term average ~10-15 Mt)
- Nutrients (mainly DIN, DON)
- Pesticides

2007 river floods of most catchments

(image: Matt Slivkoff)

Water quality in coastal and inshore areas of the GBR Lagoon



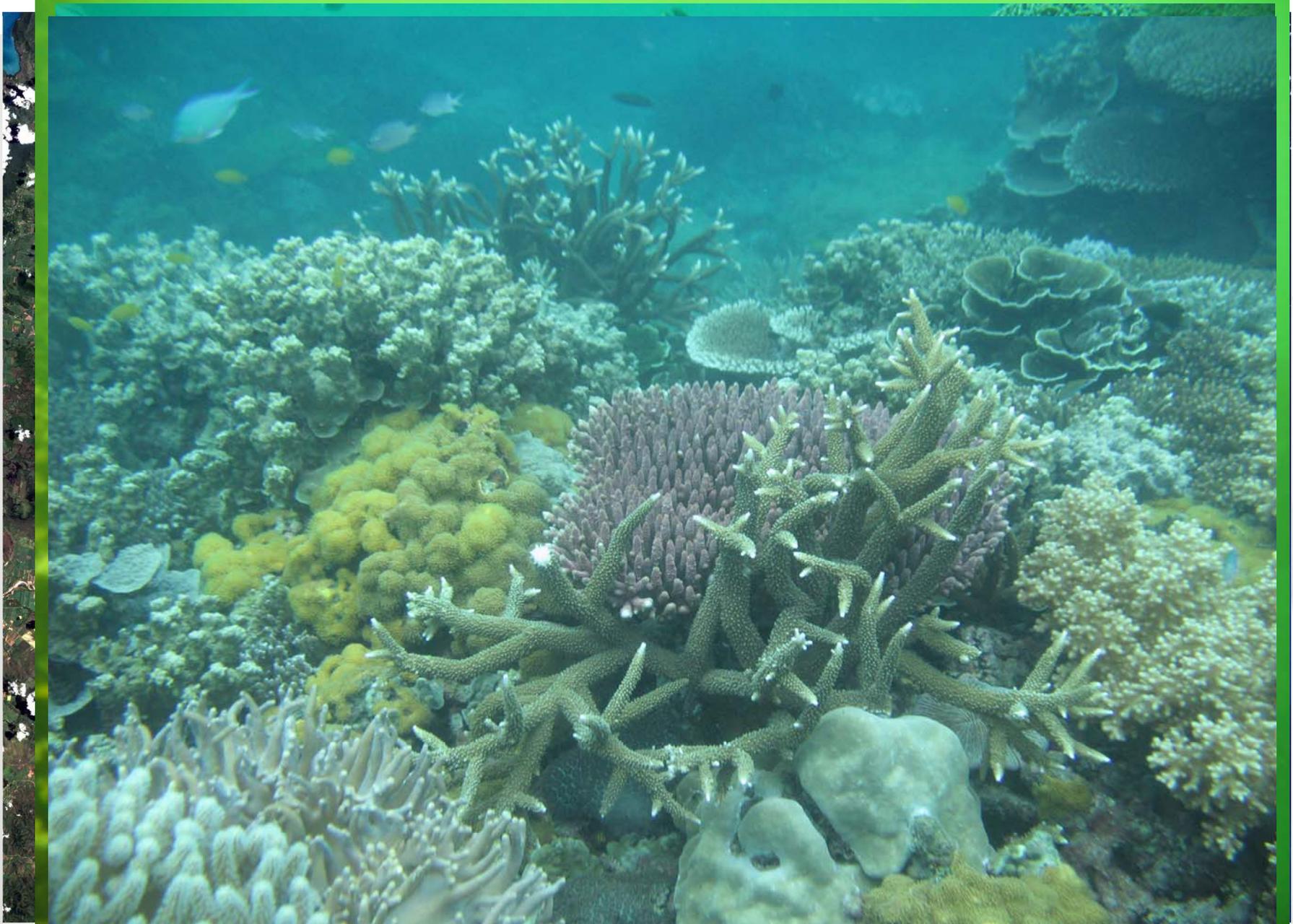
Drivers

- Inputs via monsoonal floods
- Recurrent availability via resuspension

Main problems

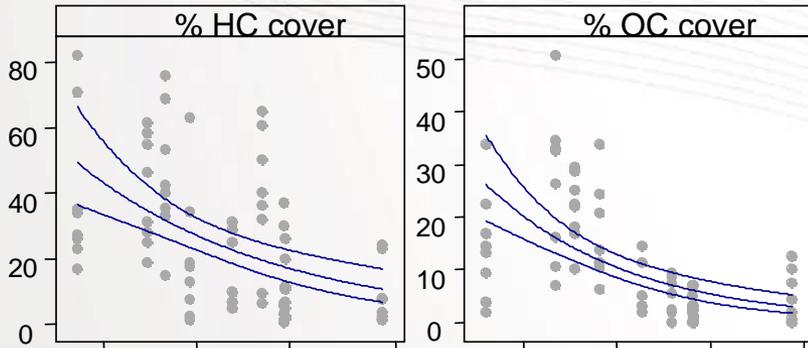
- High turbidity
- Increased chlorophyll
- Increased organic matter
- Measurable levels of herbicides

Floods and resuspension drive the system

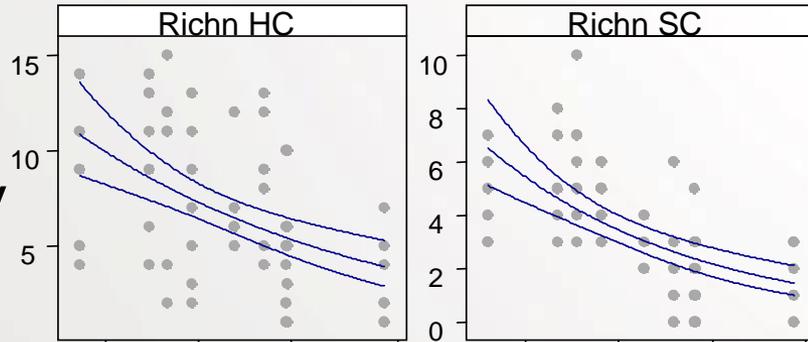


Reef communities change along WQ gradient

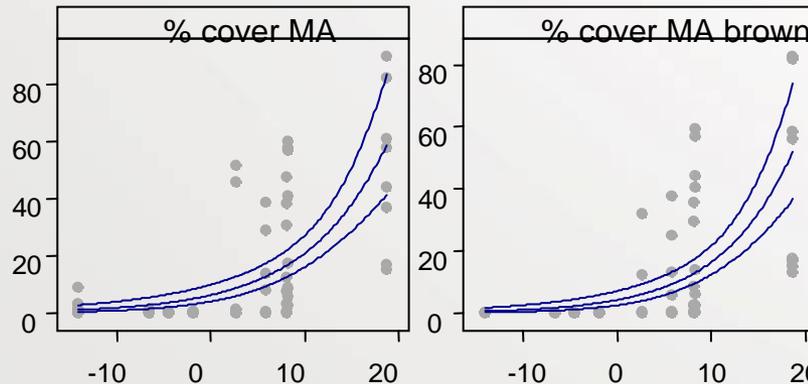
Decreasing coral cover



Decreasing Coral diversity

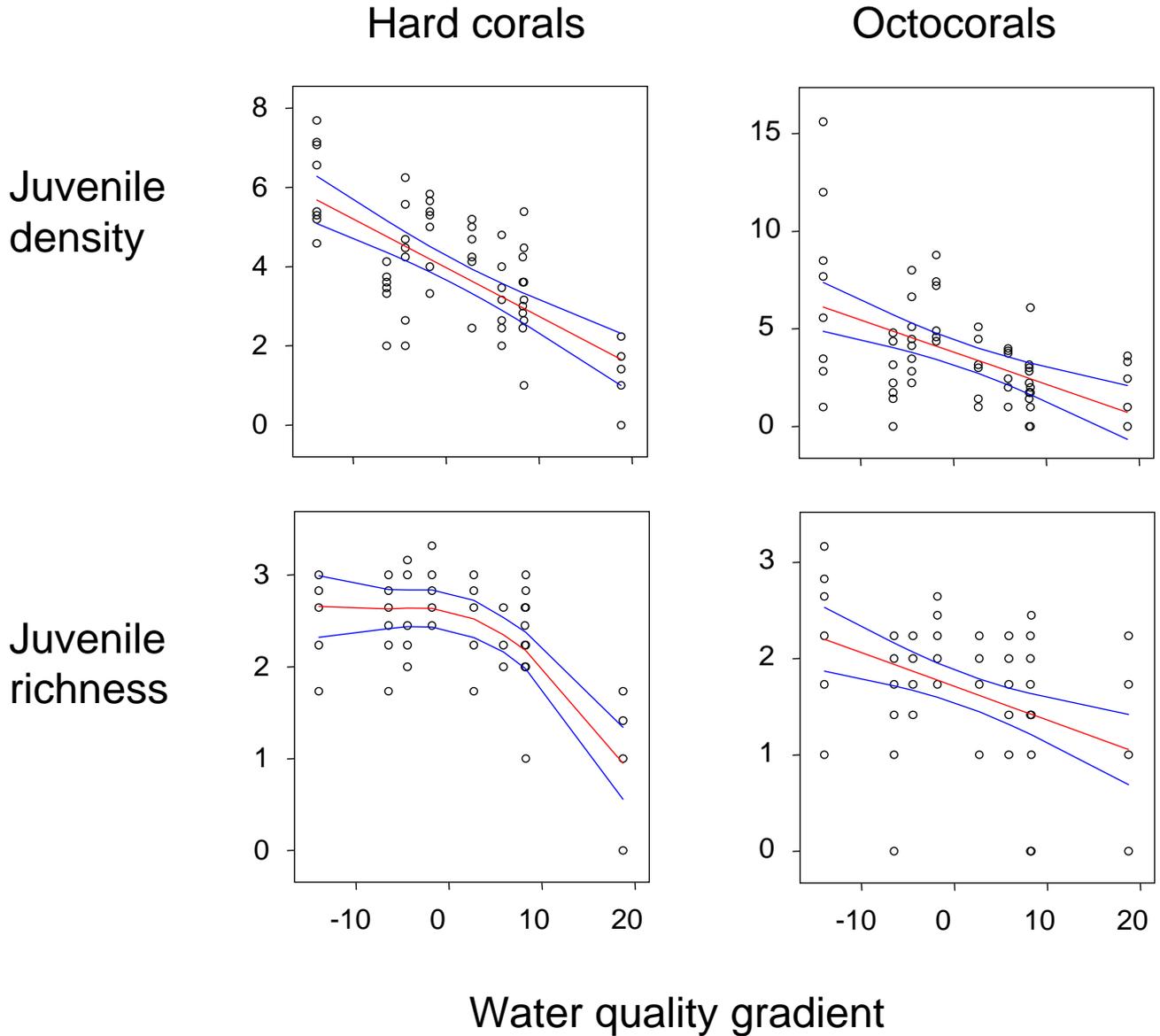


Increasing macroalgal cover

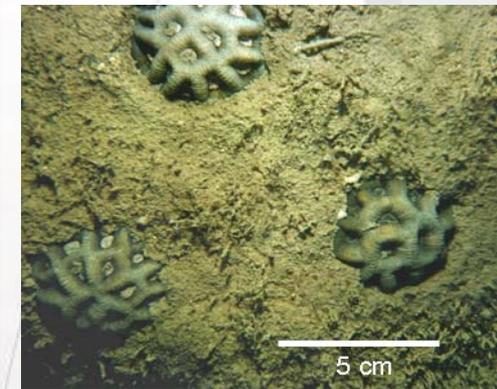


Clear ← → Turbid Clear ← → Turbid

Effects of water quality on coral reefs



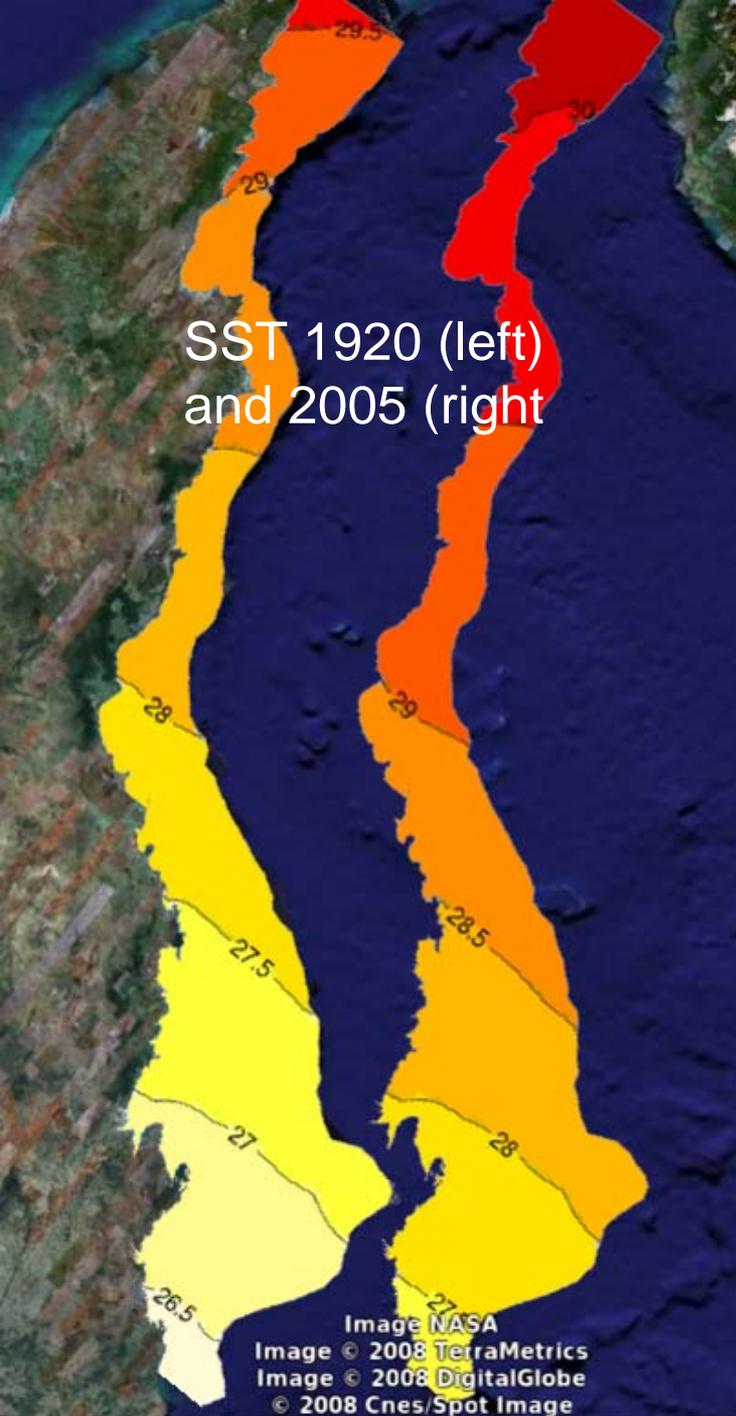
Less juvenile corals with decreasing water quality



Fabricius in prep.

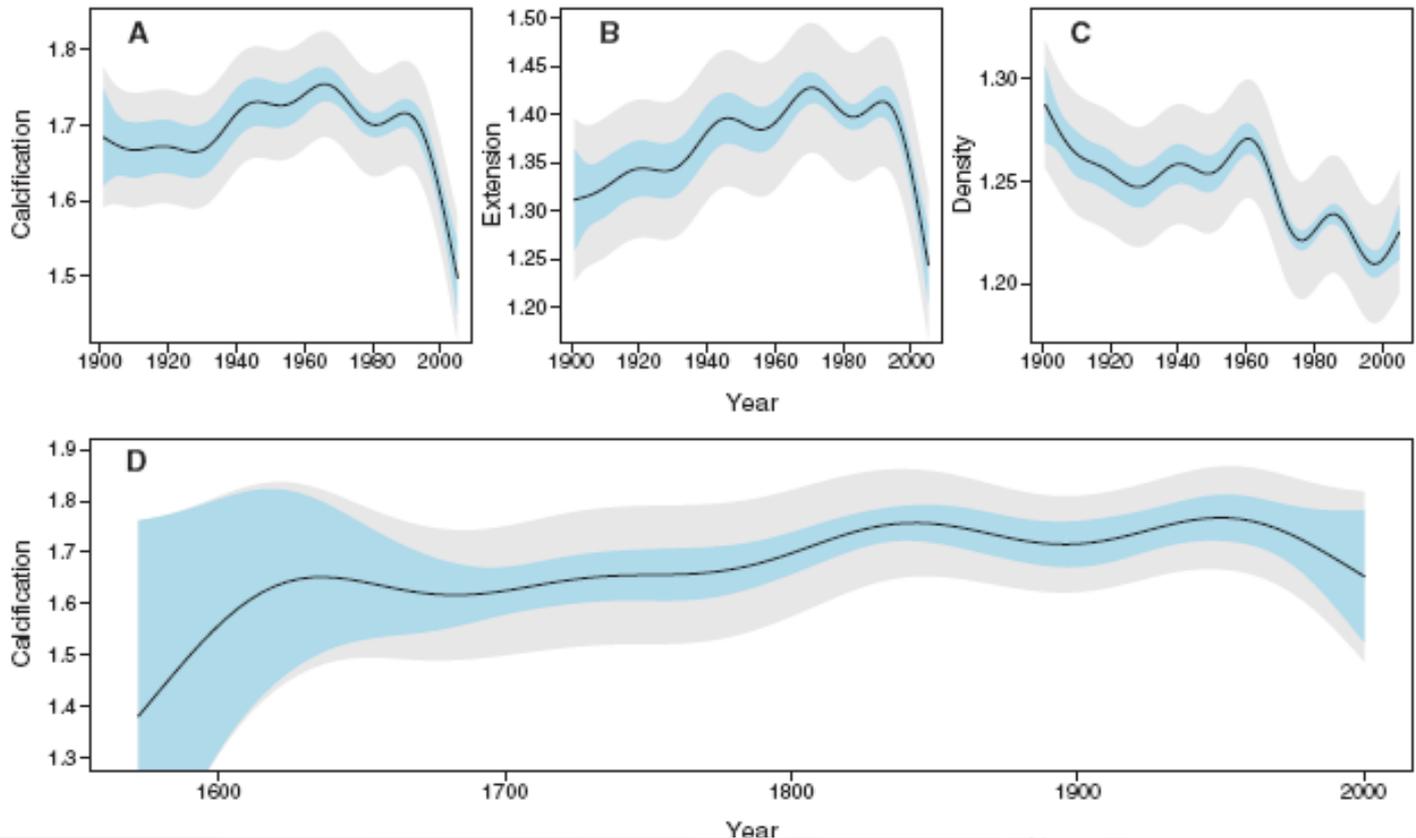
Threats to GBR:

2. Climate change



- Increased sea temperature
- More intense cyclones
- More extreme droughts/floods
- Ocean acidification

Declining coral calcification



15% decline in coral calcification

De'ath et al. (2009)
Science 323

Water quality and climate change interactions- indirect

- Climate change will lead to more disturbance of reefs
- How do reefs recover after disturbance under different water quality conditions?



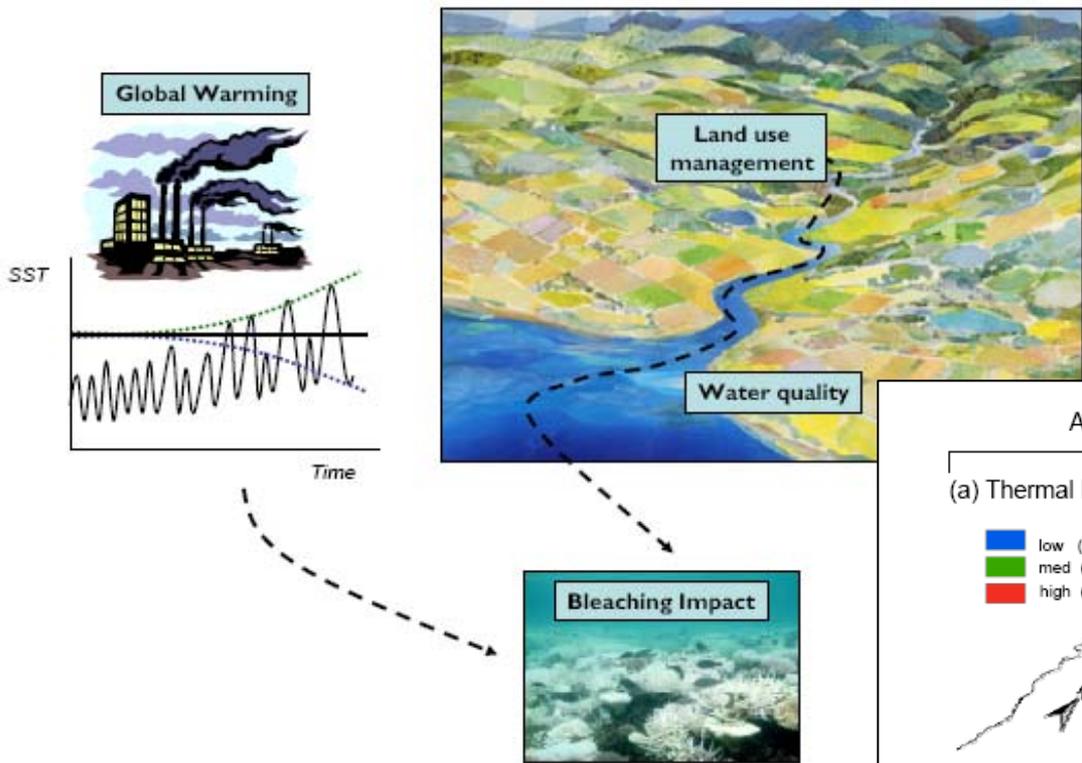
- coral recruitment & growth
- moderate algal growth, mainly turfs
→ Recovery



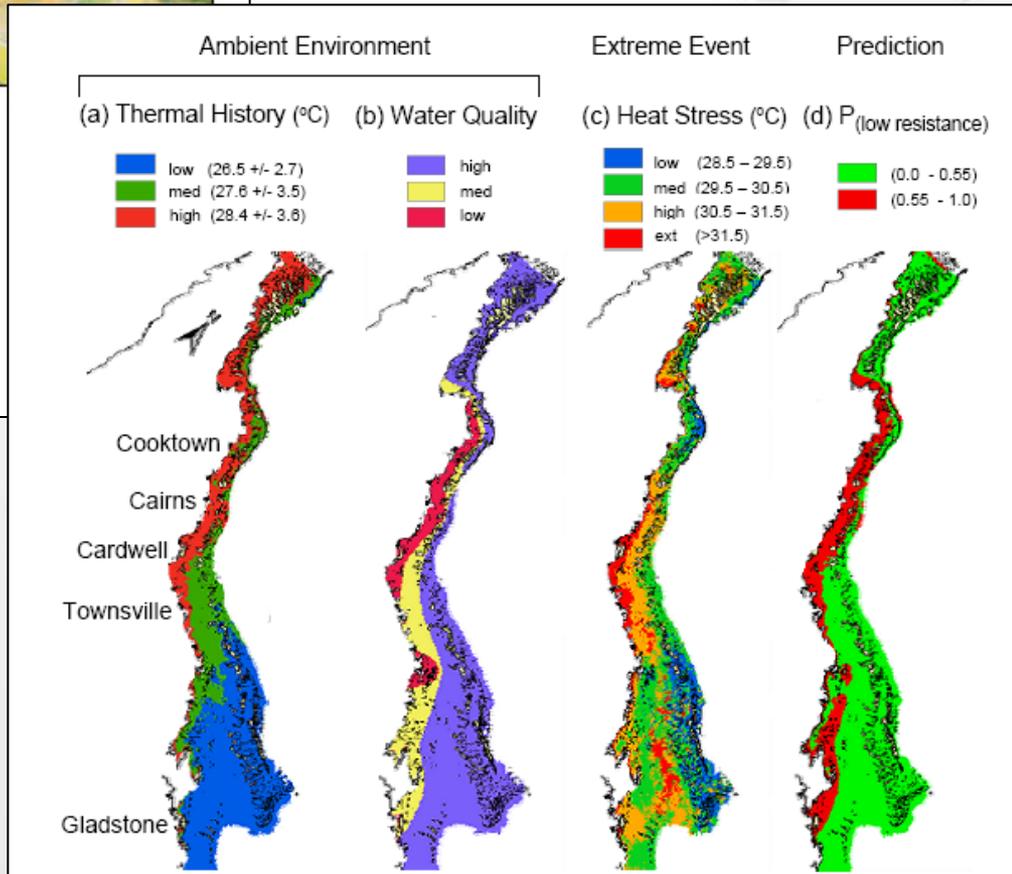
- coral recruitment reduced
- enhanced algal growth
- coral/algal competition
→ slow or no recovery, reduced diversity
=low resilience to disturbance

Water quality/climate change interactions

- direct



Coral in areas exposed to land runoff have lower resistance to bleaching



Management of water quality in the GBR lagoon

- Point sources (sewage, industrial effluent, land-based aquaculture, etc) well managed under permit processes and discharge license conditions
- Diffuse sources (e.g. agricultural run-off) managed by non-binding instruments
 - Reef Water Quality Protection Plan
 - National Action Plan for Salinity and Water Quality
 - Regional Natural Resource Management Plans
 - Water Quality Improvement Plans

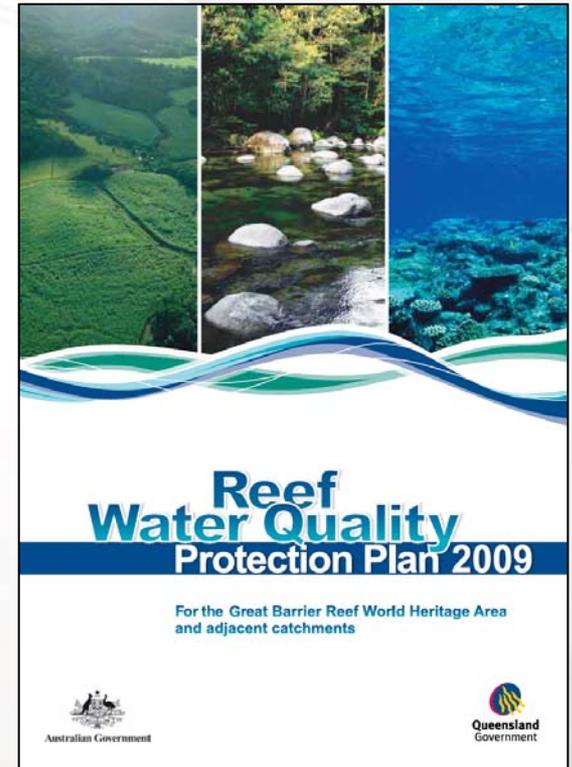
Great Barrier Reef Water Quality Protection Plan

Goals

- **2013:** Halt and reverse the decline in water quality entering the Reef by 2013.
- **2020:** To ensure that by 2020 the quality of water entering the Reef from adjacent catchments has no detrimental impact on the health and resilience of the Great Barrier Reef.

Objectives

1. Reduce the load of pollutants from non-point sources in the water entering the Reef.
2. Rehabilitate and conserve areas of the Reef catchment that have a role in removing water-borne pollutants.
(e.g., flood plains, riparian zones, mangroves)



Released 2003
Reviewed 2009

GBR water quality guideline

Australian Government
Great Barrier Reef
Marine Park Authority

**Water Quality Guidelines for
the Great Barrier Reef Marine Park.**

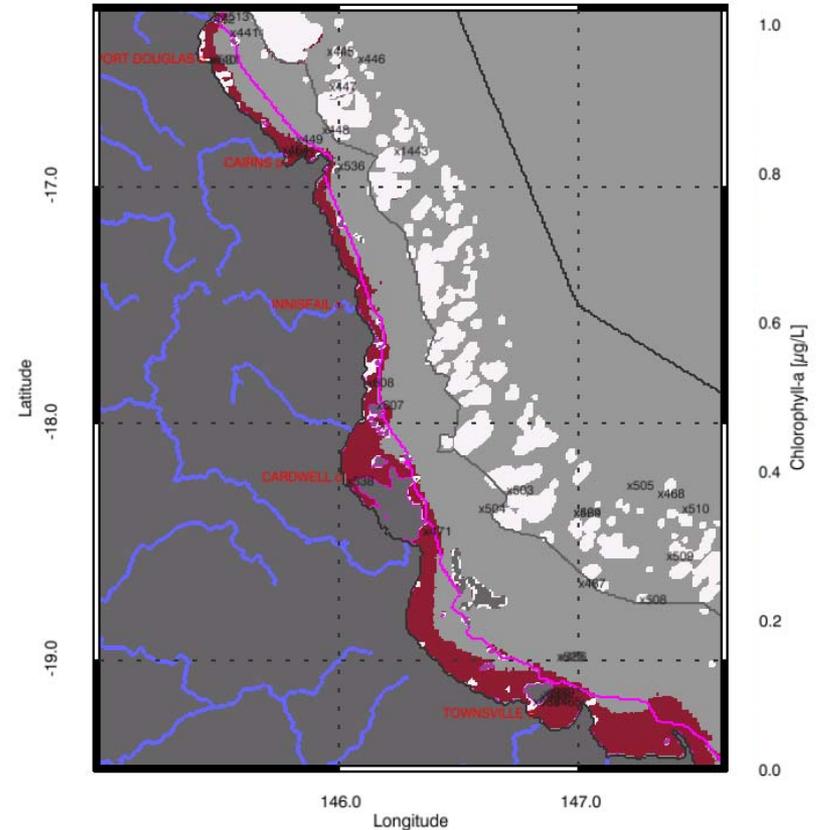
Great Barrier Reef Marine Park Authority, Townsville.



- Released 2009
- Based on empirical data
- Applied in GBR-wide WQ monitoring program

Chlorophyll-a: Mean > trigger

01-Nov-2007_31-Oct-2008



Region & date: WOIP 01-Nov-2007_31-Oct-2008
Data product: MODIS AQUA Chi_MIM (P.ANN_P123.MIM_CLU4_gLee_412_748)
Derived product:
Guidelines:



Summary

- Climate change is the main threat to the GBR
- Coral calcification has declined by ~15% since 1990,
- Regional stressors such as water quality remain important, especially for scope for recovery after disturbance
- Regional stressors such as water quality can be regionally managed!
- Climate change and water quality affect coral reefs, both alone and in interaction
- Future research and management needs to urgently address these interactions

CATCHMENT TO REEF



Thank you

Dairy grazing and land-clearing increase sediment and nutrient loads in waterways.

Modifying waterways further via artificial connections between catchments.

Catchment and Reef are ultimately connected by the water cycle, a circulation of water from the oceans to the atmosphere, to the land and back to the sea.

Caring for catchments helps protect the Reef and supports a local economy in the process.

Flood plumes occur naturally and transport the vital nutrients and animals. Catchment soils feed the flood plume, and this has been linked to Crown-of-Thorns Starfish outbreaks - a major threat to some of the Great Barrier Reef.

Reefs need waters that are generally clear and nutrient-poor so corals can use light energy for growth.

Flood plumes are the outside moving of freshwater with the major environment. They carry sediments, nutrients and chemicals from our catchments.

The tidal delta is where the catchment meets the sea. Fine sand and silt separate with sediment and organic matter to form a natural muddy barrier to the sea.

Waterways are living corridors that allow animals to move up and downstream and from land to sea. Complex food webs link the waterway with the land it flows through.

Juvenile mangrove jack fish in freshwater wetlands and streams before moving to sedules and on to offshore coral reefs.

Since European settlement we have reduced 80% of wetlands, sediment pathways to the Reef has increased 4 times, and human inputs have doubled.

Adult mangrove jack fish in and migrate through, inter-reef habitats to reach offshore reefs where they spawn. Their tiny larvae then travel back across the Great Barrier Reef lagoon to river mouths.

CONNECTIONS BETWEEN LAND AND SEA WHAT WE DO IN OUR CATCHMENT AFFECTS THE REEF

One of the most immediate threats to the health of the Great Barrier Reef is runoff from the land. The way we use our catchments affects the health of local waterways, and ultimately the Great Barrier Reef. Much is being done to look after our waterways and you can find out more from the 'ARE YOU CONNECTED?' booklet that came with this poster.

